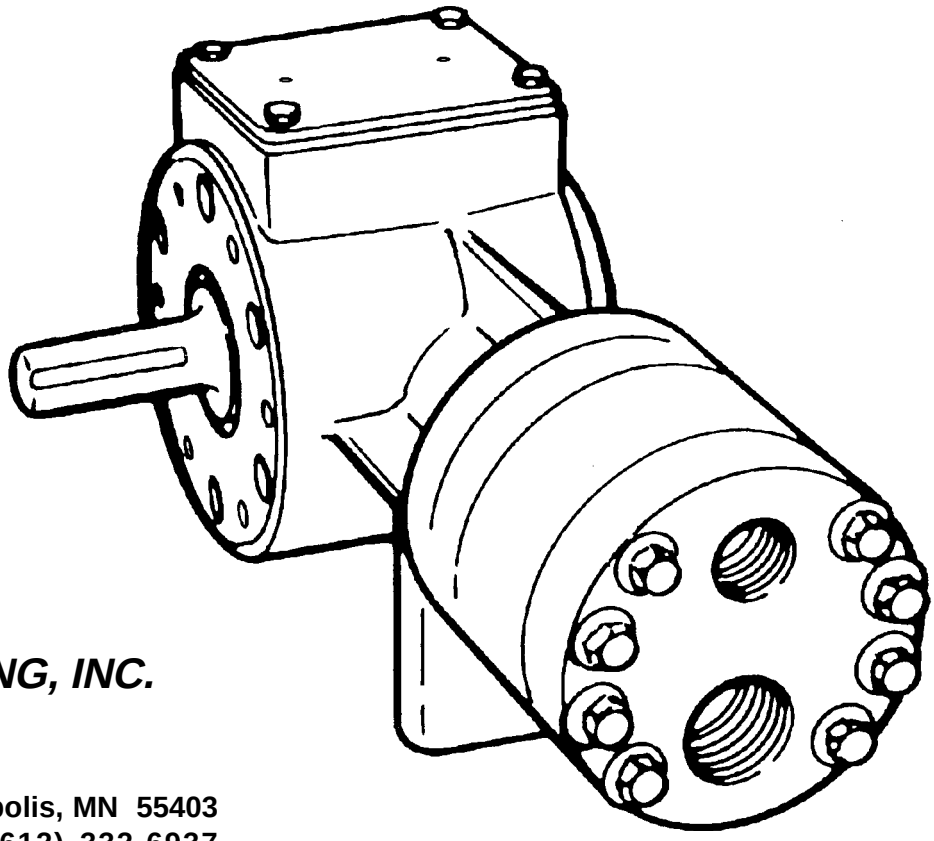
INSTALLATION & SERVICE

Hydra-Cell®

INDUSTRIAL PUMPS

Models: F-20, F-21, F-22
G-20, G-21, G-22



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F/G-20 Contents

F/G-20 Specifications

Max Pressure

Metallic:	F/G-20: 1000 psi (70 bar); F/G-21/22: 1500 psi (100 bar)
Non-Metallic:	All Models: 250 psi (17 bar)

Capacity @ Max Pressure

	rpm	gpm	l/min
F/G-20-X	1750	0.96	3.63
F/G-20-E	1750	0.73	2.76
F/G-20-S	1750	0.55	2.08
F/G-20-B	1750	0.33	1.25
F/G-20-G	1750	0.20	0.76

Delivery @ Max Pressure

	revs/gal	revs/liter
F/G-20-X	1823	500
F/G-20-E	2397	659
F/G-20-S	3182	906
F/G-20-B	5303	1400
F/G-20-G	8750	2302

Max Inlet Pressure	100 psi (7 bar)
Max Temperature	
Metallic Heads:	250°F (121°C) – consult factory for temperatures above 160°F (71°C)
Non-Metallic Heads:	140°F (60°C)
Inlet Port	F-20: 1/2 inch NPT G-20: 1/2 inch BSPT
Discharge Port	F-20: 3/8 inch NPT G-20: 3/8 inch BSPT
Shaft Diameter	F-20: 5/8 inch hollow shaft for NEMA 56C C-Face motor (with feet) F-21/22: 5/8 inch G-20: 19 mm for IEC 80 B5 Flange motor (with feet) G-21/22: 19 mm
Shaft Rotation	Bi-directional
Bearings	Radial ball
Oil Capacity	1/8 US quart (0.12 liters)
Weight	Metallic Head: 12 lbs (5.5 kg) Non-Metallic Head: 9 lbs (4.1 kg)

Calculating Required Horsepower (kW)*

$$\frac{2 \times rpm}{63{,}000} + \frac{gpm \times psi}{1{,}460} = \text{electric motor HP*}$$

$$\frac{2 \times rpm}{84{,}428} + \frac{lpm \times bar}{511} = \text{electric motor kW*}$$

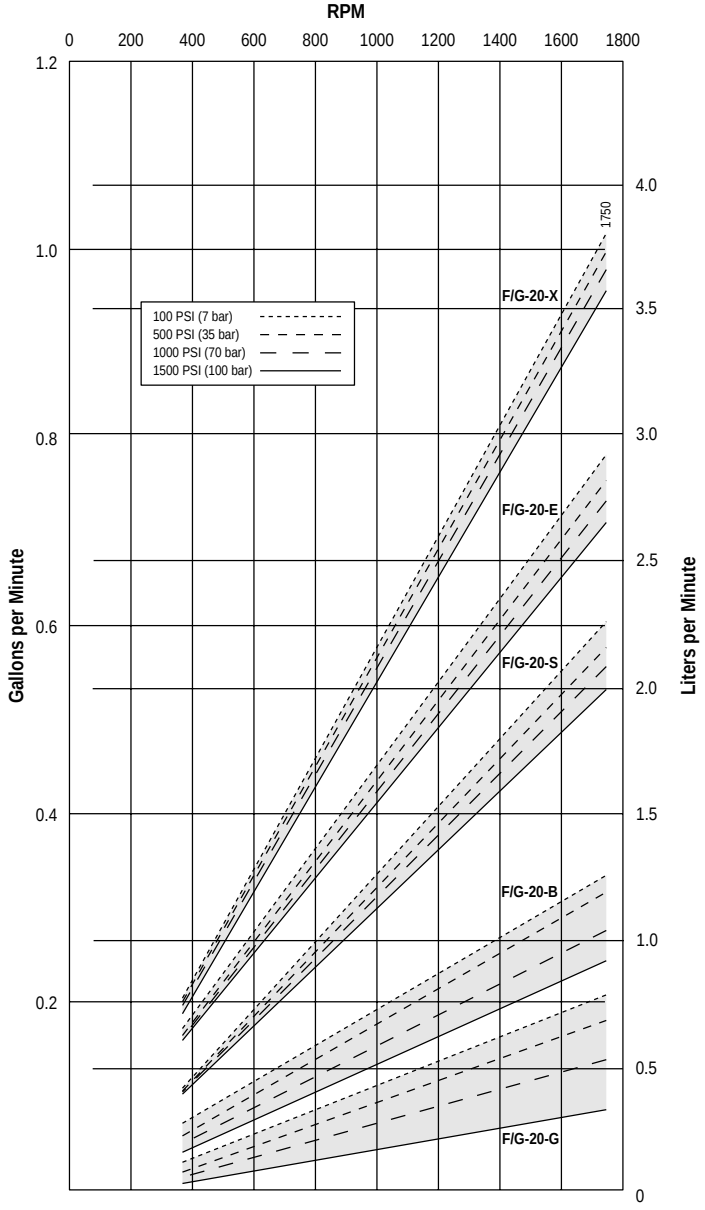
* rpm equals pump shaft rpm. HP/kW is required application power. Use caution when sizing motors with variable speed drives.

Note:

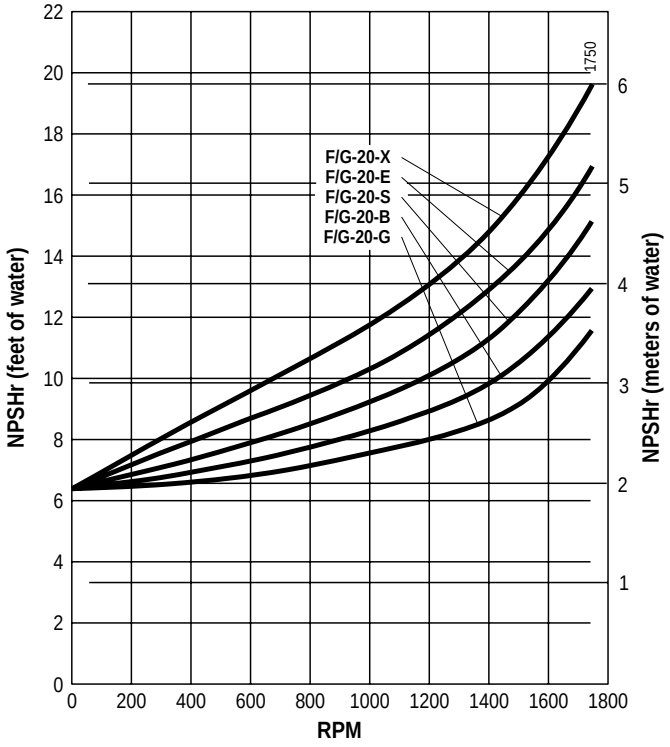
Performance and specification ratings apply to all configurations unless specifically noted otherwise.

F/G-20 Specifications

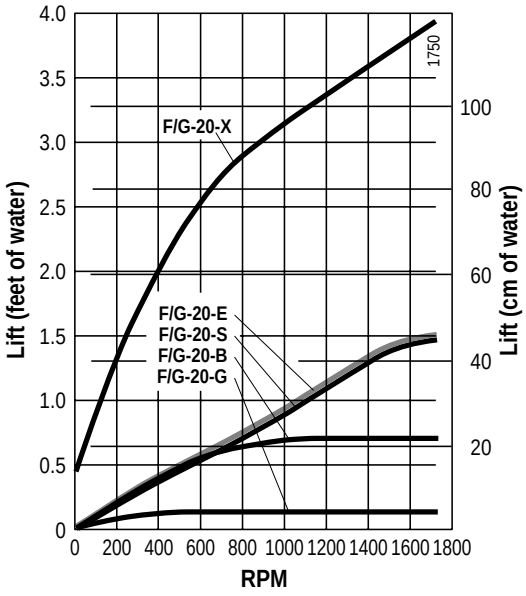
Performance



Net Positive Suction Head – NPSHr



Dry Lift



Note:

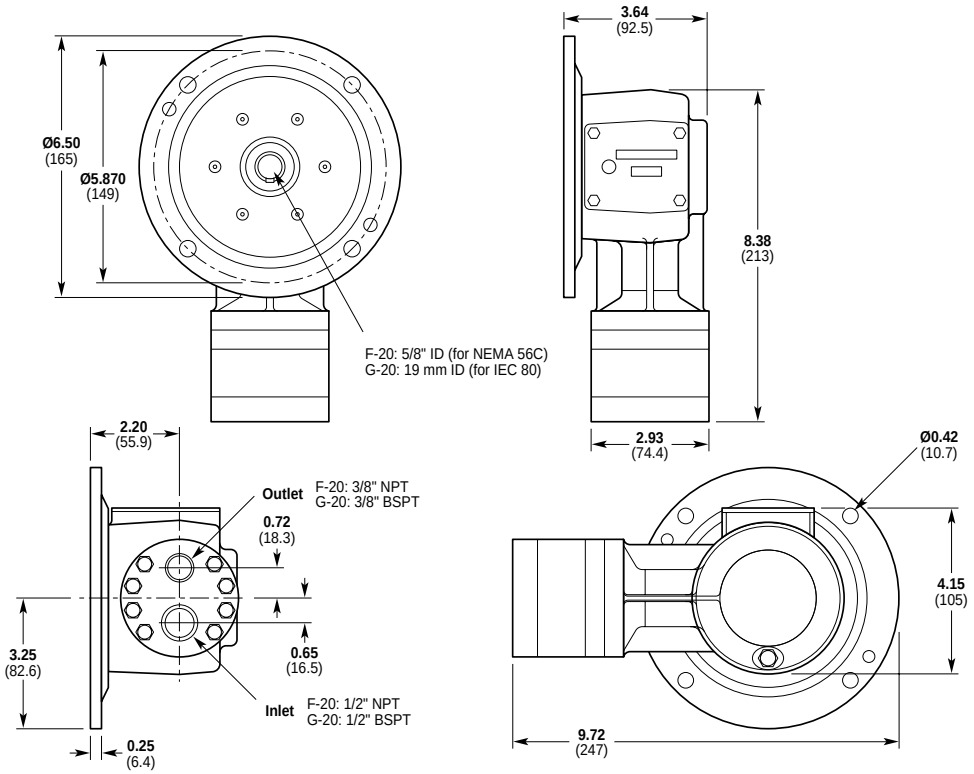
Performance and specification ratings apply to all configurations unless specifically noted otherwise.

F/G-20 Dimensions

F-20/G-20 Models with Metallic Pumping Head

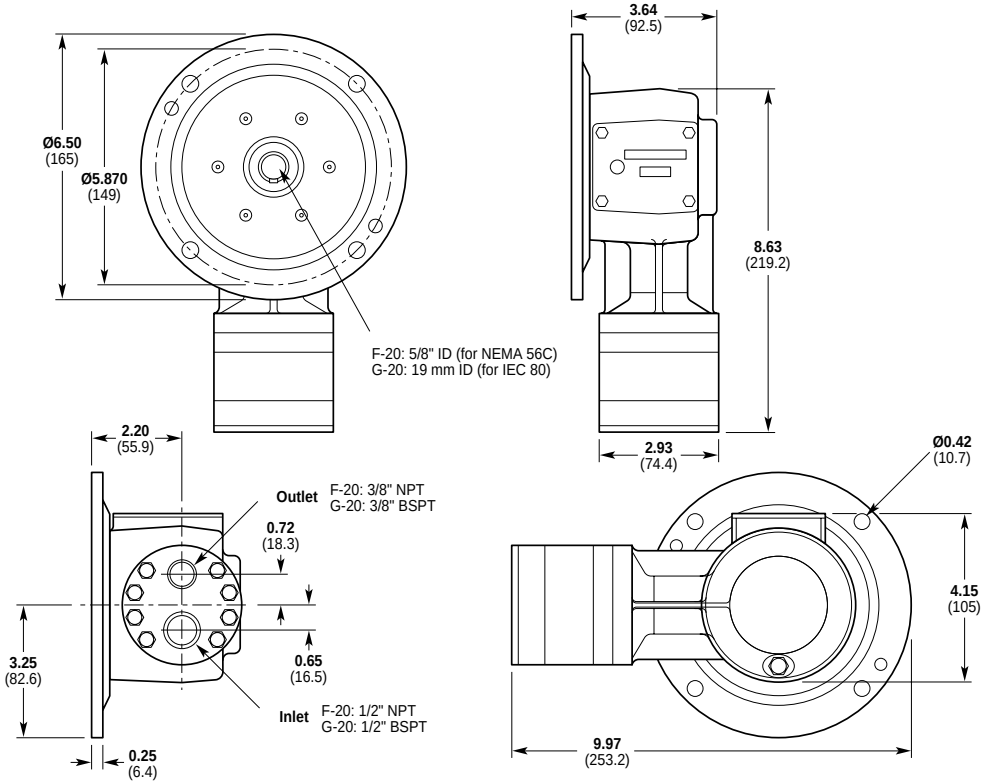
Inches (mm)

Brass
316 Stainless Steel
Hastelloy® C



F-20/G-20 Models with Non-Metallic Pump Head

Kynar®
Polypropylene



F/G-20 Dimensions

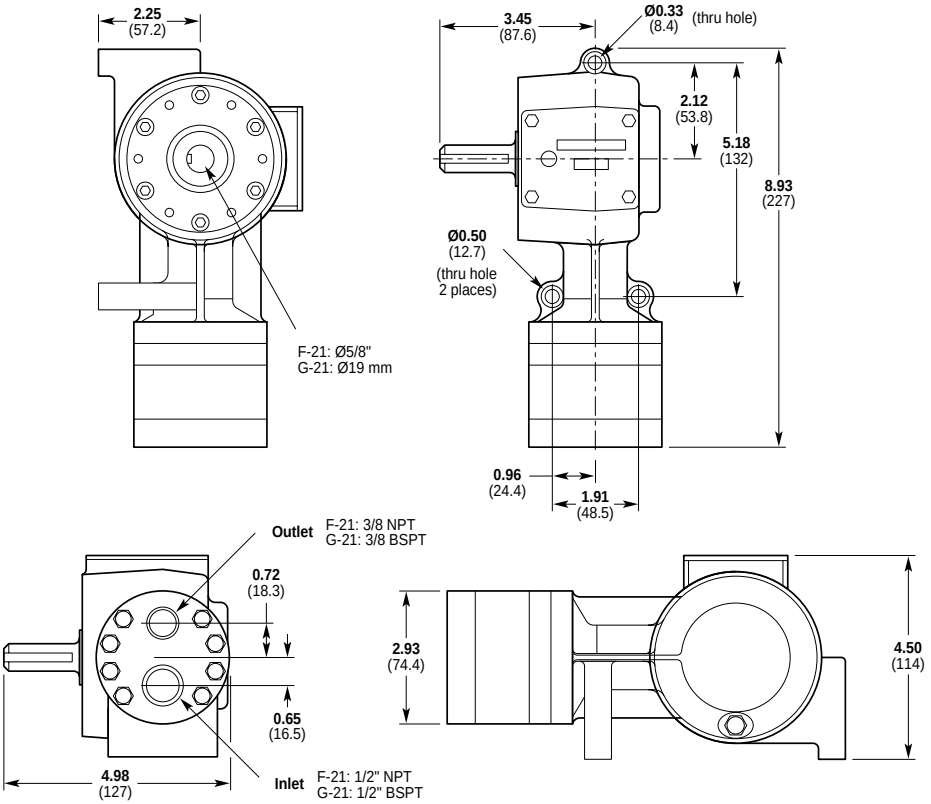
F-21/G-21 Models with Metallic Pumping Head

Inches (mm)

Brass

316 Stainless Steel

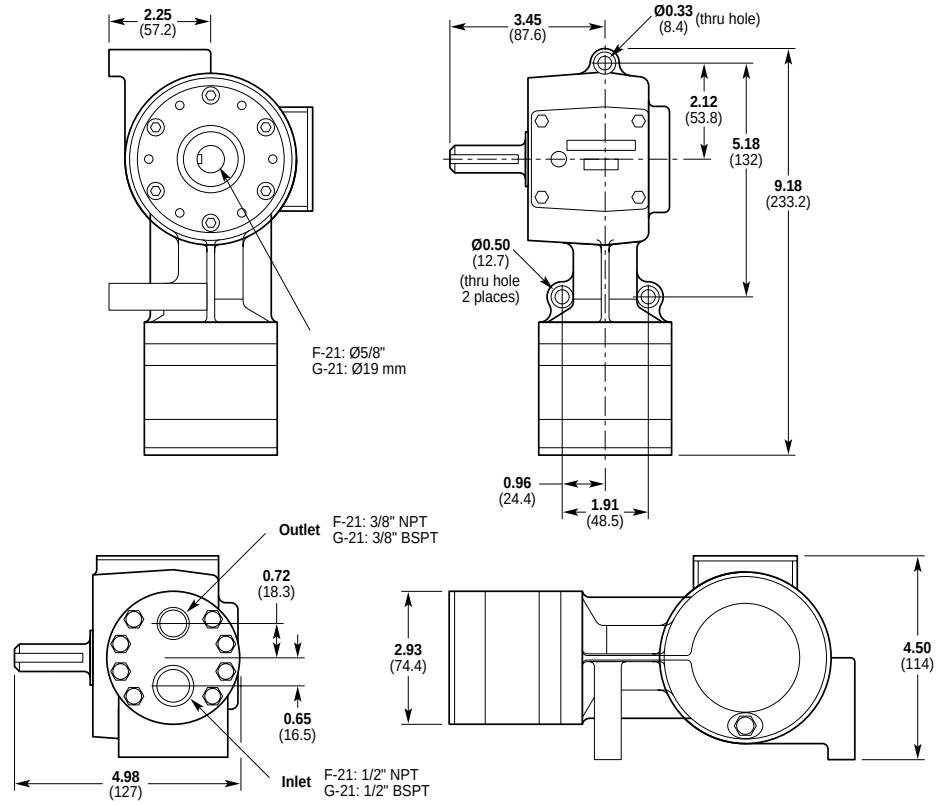
Hastelloy® C



F-21/G-21 Models with Non-Metallic Pump Head

Kynar®

Polypropylene

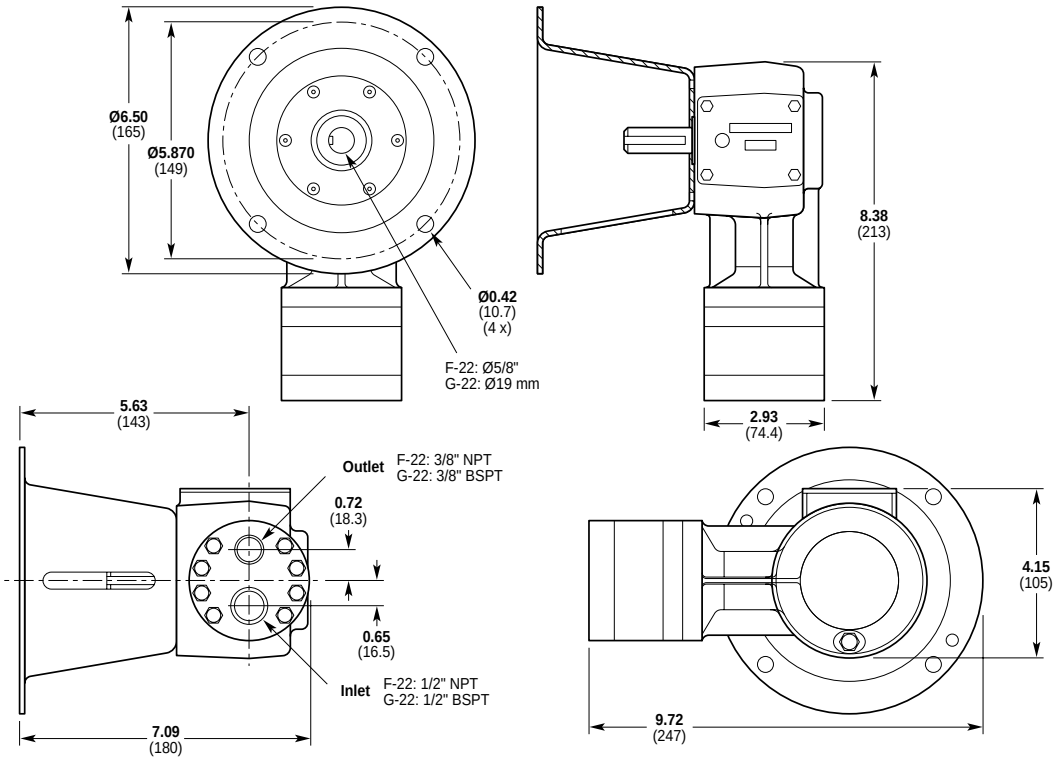


F/G-20 Dimensions

F-22/G-22 Models with Metallic Pumping Head

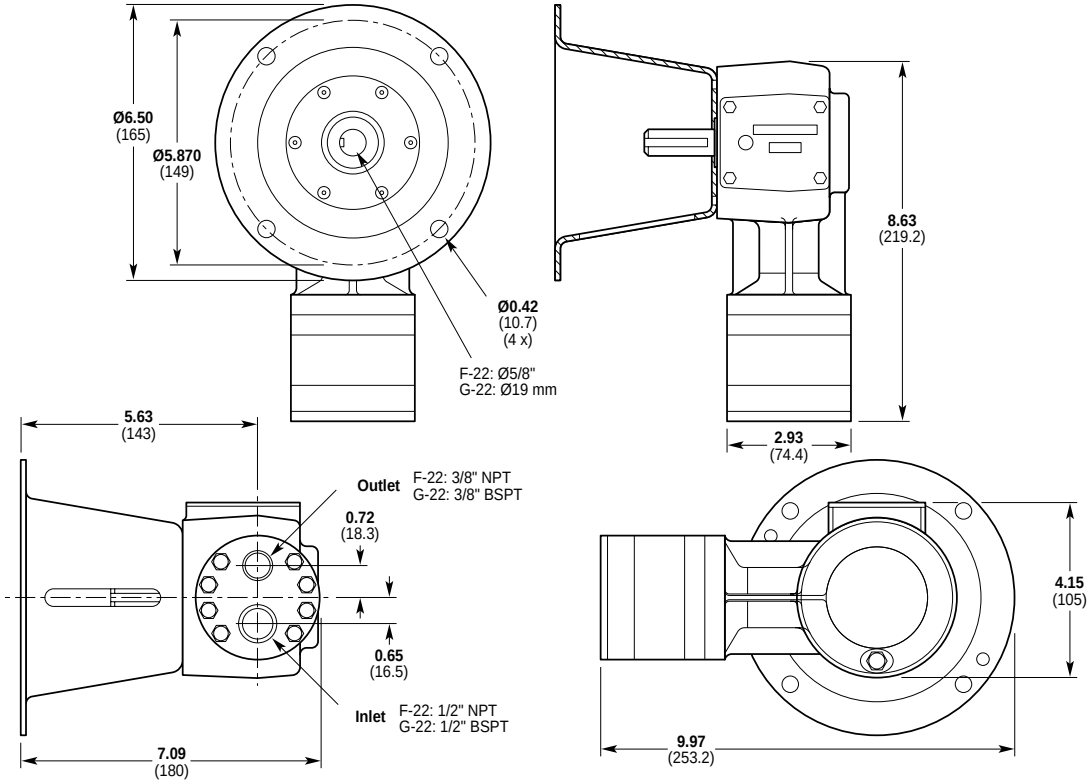
Inches (mm)

Brass
316 Stainless Steel
Hastelloy® C



F-22/G-22 Models with Non-Metallic Pump Head

Kynar®
Polypropylene



F/G-20 Installation

Location

NOTE: The numbers in parentheses are the Reference Numbers on the illustrations found later in this manual and in the Parts Manual.

Locate the pump as close to the supply source as possible.

Install it in a lighted clean space where it will be easy to inspect and maintain. Allow room for checking the oil level, changing the oil, and removing the manifold (3) and valve plate (21).

Mounting

The pump shaft can be rotated in either direction. To prevent vibration, securely attach the pump or motor to a rigid base.

On a belt-drive system, align the sheaves accurately: poor alignment wastes horsepower and shortens the belt and bearing life. Make sure the belts are properly tightened, as specified by the belt manufacturer.

On a direct-drive system, align the shafts accurately.

On a close-coupled system, coat the motor shaft liberally with Loctite® Nickel Anti-Seize #77164.

Important Precautions

Adequate Fluid Supply. To avoid cavitation and premature pump failure, be sure that the pump will have an adequate fluid supply and that the inlet line will not be obstructed. See “Inlet Piping”.

Positive Displacement. This is a positive-displacement pump. To avoid severe system damage if the discharge line ever becomes blocked, install a relief valve downstream from the pump. See “Discharge Piping”.

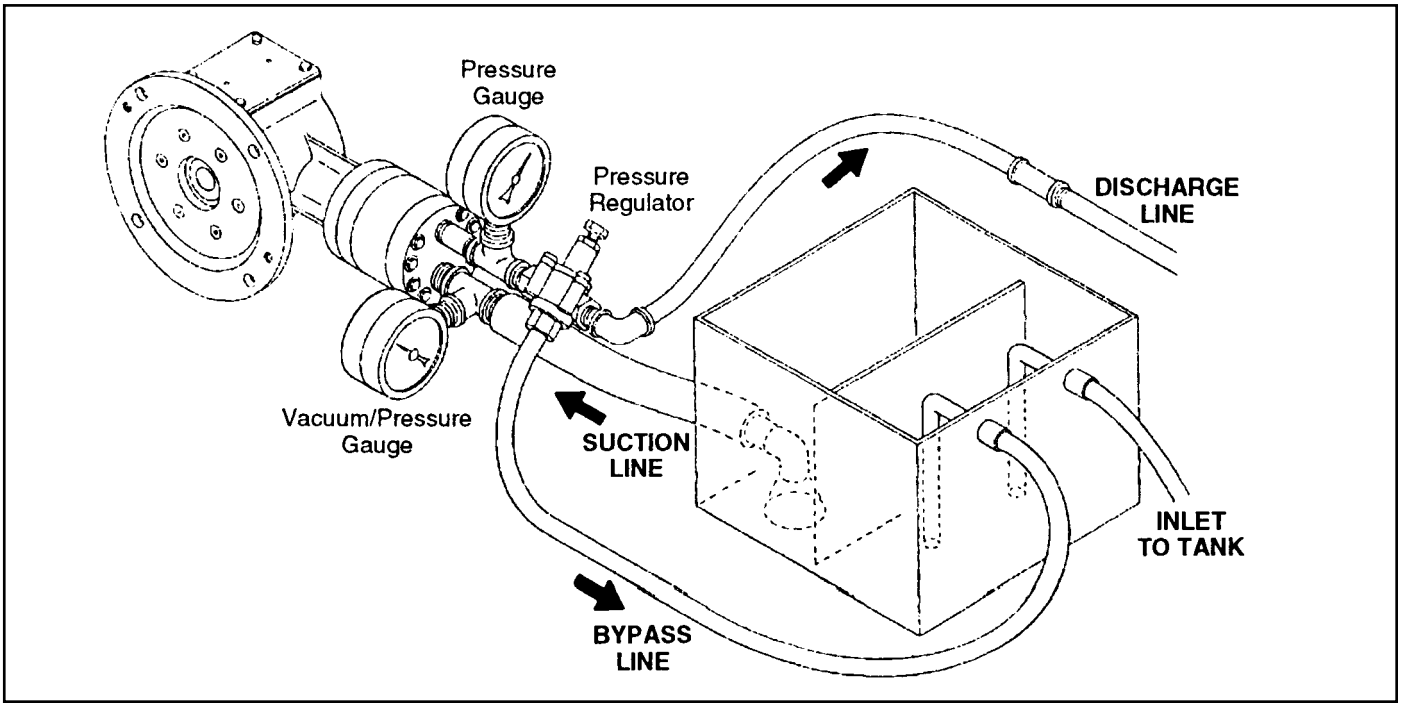
Safety Guards. Install adequate safety guards over all pulleys, belts, and couplings. Follow all codes and regulations regarding installation and operation of the pumping system.

Shut-Off Valves. Never install shut-off valves between the pump and discharge pressure regulator, or in the regulator bypass line.

Freezing Conditions. Protect the pump from freezing. See also the Maintenance Section.

Consult the Factory for the following situations:

- Extreme temperature applications (above 160° F or below 40° F)
- Pressure feeding of pumps
- Viscous or abrasive fluid applications
- Chemical compatibility problems
- Hot ambient temperatures (above 110° F)
- Conditions where pump oil may exceed 200° F because of a combination of hot ambient temperatures, hot fluid temperature, and full horsepower load — an oil cooler may be required



F/G-20 Installation

Inlet Piping (Suction Feed)

CAUTION: When pumping at temperatures above 160° F (71°C), use a pressure-feed system.

Install draincocks at any low points of the suction line, to permit draining in freezing conditions.

Provide for permanent or temporary installation of a vacuum gauge to monitor the inlet suction. To maintain maximum flow, vacuum at the pump inlet should not exceed 7 in. Hg (180 mm Hg). **Do not supply more than one pump from the same inlet line.**

Supply Tank

Use a supply tank that is large enough to provide time for any trapped air in the fluid to escape. The tank size should be at least twice the maximum pump flow rate.

Isolate the pump and motor stand from the supply tank, and support them separately.

Install a separate inlet line from the supply tank to each pump.

Install the inlet and bypass lines so they empty into the supply tank below the lowest water level, on the opposite side of the baffle from the pump suction line.

If a line strainer is used in the system, install it in the inlet line to the supply tank.

To reduce aeration and turbulence, install a completely submerged baffle plate to separate the incoming and outgoing liquids.

Install a vortex breaker in the supply tank, over the outlet port to the pump.

Place a cover over the supply tank, to prevent foreign objects from falling into it.

Hose and Routing

Size the suction line at least one size larger than the pump inlet, and so that the velocity will not exceed 1-3 ft/sec (0.3 to 0.9 m/s):

For pipe in inches: Velocity (ft/sec) = 0.408 x GPM/Pipe ID^2

For pipe in mm: Velocity (m/sec) = 21.2 x LPM/Pipe ID^2

Keep the suction line as short and direct as possible.

Use flexible hose and/or expansion joints to absorb vibration, expansion, or contraction.

If possible, keep the suction line level. Do not have any high points to collect vapor unless these high points are vented.

To reduce turbulence and resistance, do not use 90° elbows. If turns are necessary in the suction line, use 45° elbows or arrange sweeping curves in the flexible inlet hose.

If a block valve is used, be sure it is fully opened so that the flow to the pump is not restricted. The opening should be at least the same diameter as the inlet plumbing ID.

Do not use a line strainer or filter in the suction line unless regular maintenance is assured. If used, it should have a free-flow area of at least three times the free-flow area of the inlet.

Install piping supports where necessary to relieve strain on the inlet line and to minimize vibration.

Inlet Piping (Pressure Feed)

Provide for permanent or temporary installation of a vacuum/pressure gauge to monitor the inlet vacuum or pressure. Pressure at the pump inlet should not exceed 250 psi (173 bar); if it could get higher, install an inlet pressure regulator. **Do not supply more than one pump from the same inlet line.**

Inlet Calculations

Acceleration Head

Calculating the Acceleration Head

Use the following formula to calculate acceleration head losses. Subtract this figure from the NPSHa, and compare the result to the NPSHr of the Hydra-Cell pump.

Ha = (L x V x N x C) ÷ (K x G)

where:

Ha = Acceleration head (ft of liquid)

L= Actual length of suction line (ft) — not equivalent length

V= Velocity of liquid in suction line (ft/sec) [V = GPM x (0.408 ÷ pipe ID^2)]

N= RPM of crank shaft

C= Constant determined by type of pump — use 0.628 for the F/G-20/21/22 Hydra-Cell pump

K= Constant to compensate for compressibility of the fluid — use: 1.4 for de-aerated or hot water; 1.5 for most liquids; 2.5 for hydrocarbons with high compressibility

G= Gravitational constant (32.2 ft/sec^2)

Friction Losses

Calculating Friction Losses in Suction Piping

When following the above recommendations (under “inlet Piping”) for minimum hose/pipe I.D. and maximum length, frictional losses in the suction piping are negligible (i.e., Hf = 0) if you are pumping a water-like fluid.

When pumping more-viscous fluids such as lubricating oils, sealants, adhesives, syrups, varnishes, etc., frictional losses in the suction piping may become significant. As Hf increases, the available NPSH (NPSHa) will decrease, and cavitation will occur.

In general, frictional losses increase with increasing viscosity, increasing suction-line length, increasing pump flowrate, and decreasing suction-line diameter. Changes in suction-line diameter have the greatest impact on frictional losses: a 25% increase in suction-line diameter cuts losses by more than two times, and a 50% increase cuts losses by a factor of five times.

Consult the factory before pumping viscous fluids.

Minimizing Acceleration Head and Frictional Losses

To minimize the acceleration head and frictional losses:

- Keep inlet lines less than 1 ft (0.3 m) long (suction stabilizer required for longer inlet lines)
- Use at least 5/8 in. (16 mm) I.D. inlet hose
- Use soft hose (low-pressure hose, noncollapsing) for the inlet lines
- Minimize fittings (elbows, valves, tees, etc.)
- **Use a suction stabilizer on the inlet.**

Minimizing Acceleration Head and Frictional Losses

To minimize the acceleration head:

- Keep inlet lines less than 3 ft (1 m) long
- Use at least 5/8" (16mm) I.D. inlet hose
- Use soft hose (low-pressure hose, noncollapsing) for the inlet lines
- Minimize fittings (elbows, valves, tees, etc.)
- **Use a suction stabilizer on the inlet.**

Net Positive Suction Head

NPSHa must be equal to or greater than NPSHr. If not, the pressure in the pump inlet will be lower than the vapor pressure of the fluid— and cavitation will occur.

Calculating the NPSHa

Use the following formula to calculate the NPSHa:

NPSHa = Pt + Hz - Hf - Ha - Pvp

where:

Pt = Atmospheric pressure

Hz = Vertical distance from surface liquid to pump centerline (if liquid is below pump centerline, the Hz is negative)

Hf = Friction losses in suction piping

Ha = Acceleration head at pump suction

Pvp = Absolute vapor pressure of liquid at pumping temperature

NOTES:

- In good practice, NPSHa should be 2 ft greater than NPSHr
- All values must be expressed in feet of liquid

Atmospheric Pressure at Various Altitudes

Altitude (ft)	Pressure (ft of H_2O)	Altitude (ft)	Pressure (ft of H_2O)
0	33.9	1500	32.1
500	33.3	2000	31.5
1000	32.8	5000	28.2

Discharge Piping

Note: Consult the Factory before manifolding two or more pumps together.

Hose and Routing

Use the shortest, most-direct route for the discharge line.

Select pipe or hose with a **working pressure** rating of at least 1.5 times the maximum system pressure. EXAMPLE: Select a 1500 psi (103 bar) W.P.-rated hose for systems to be operated at 1000 psi (69 bar) gauge pressure.

Use about 6 ft (1.8 m) of flexible hose between the pump and rigid piping to absorb vibration, expansion or contraction.

Support the pump and piping independently. Size the discharge line so that the velocity of the fluid will not exceed 7-10 ft/sec (2-3 m/sec):

For pipe in inches: Velocity (ft/sec) = 0.408 x GPM/Pipe ID^2

For pipe in mm: Velocity (m/sec) = 21.2 x LPM/Pipe ID^2

Pressure Regulation

Install a pressure regulator or unloader in the discharge line. Bypass pressure must not exceed the pressure limit of the pump.

Size the regulator so that, when fully open, it will be large enough to relieve the full capacity of the pump without overpressurizing the system.

Locate the valve as close to the pump as possible and ahead of any other valves.

Adjust the pressure regulating valve to no more than 10% over the maximum working pressure of the system. Do not exceed the manufacturer's pressure rating for the pump or regulator.

Route the bypass line to the supply tank, or to the suction line as far as possible from the pump (to reduce the chance of turbulence).

If the pump will be operating for a long time with the discharge closed and fluid bypassing, install a thermal protector set to trip at 140° F in the bypass line (to prevent severe temperature buildup in the bypassed fluid).

CAUTION: *Never* install shutoff valves in the bypass line or between the pump and pressure regulator or relief valve.

Provide for permanent or temporary installation of a pressure gauge to monitor the discharge pressure at the pump.

For additional system protection, install a safety relief valve in the discharge line, downstream from the pressure regulator.

F/G-20 Installation

Before Initial Start-Up

Before you start the pump, be sure that:

- All shut-off valves are open, and the pump has an adequate supply of fluid.
- All connections are tight.
- The oil reservoir beneath the reservoir diaphragm (71) is completely full. NOTE: The reservoir is filled and sealed at the factory. If you are unsure about the oil level, remove the cover (70) and slowly lift the diaphragm (71). Refer to Service Procedure #6, “Fill and Seal the Oil Reservoir”, in the Fluid-End Service Section.
- The relief valve on the outlet of the pump is adjusted so the pump starts under minimum pressure.
- All pulleys and belts are properly aligned, and belts are tensioned according to specification.
- All pulleys and belts have adequate safety guards.

Initial Start-Up Procedure

1. Turn on power to the pump motor.
2. Check the inlet pressure or vacuum. To maintain maximum flow, inlet vacuum must not exceed 7 in. Hg. Inlet pressure must not exceed 250 psi (17.3 bar).
3. Listen for any erratic noise and look for unsteady flow.
4. If the system has an air lock and the pump fails to prime:
   a. Turn off the power.
   b. Remove the pressure gauge or plug from the tee fitting at the pump outlet (refer to the illustration on page 3).

   NOTE: Fluid may come out of this port when the plug is removed. Provide an adequate catch basin for fluid spillage, if required. Fluid will come out of this port when the pump is started, so we recommend that you attach adequate plumbing from this port so fluid will not be sprayed or lost. Use high-pressure-rated hose and fittings from this port. Take all safety precautions to assure safe handling of the fluid being pumped.

   c. Jog the system on and off until the fluid coming from this port is air-free.
   d. Turn off the power.
   e. Remove the plumbing that was temporarily installed, and reinstall the pressure gauge or plug.
5. Adjust the discharge pressure regulator to the desired operating and bypass pressures. Do not exceed the maximum pressure rating of the pump.
6. After the pressure regulator is adjusted, set the “pop-off” safety relief valve at 100 psi higher than the desired operating pressure.
7. Pumps fitted with Teflon diaphragms require 2 psi (0.14 bar) minimum inlet pressure.

NOTE: The numbers in parentheses are the Ref. Nos. on the illustrations in the Parts Manual.

Periodically

Change the oil after the first 100 hours of operation, then change according to the guidelines below. When changing, remove the drain plug (69), Allow all oil and contaminant to drain out.

Hours Between Oil Changes @ Various Process Fluid Temperatures

Pressure	RPM	<90°F (32°C)	<139°F (60°C)	<180°F (82°C)
Metallic Pump Head				
<1000 psi (70 bar)	<1200	6,000	4,000	2,000
	<1800	3,000	2,000	1,500
<1500 psi (100 bar)	<1200	3,000	2,000	1,500
	<1800	1,500	1,000	1,000
Non-Metallic Pump Head				
<250 psi (17 bar)	<1200	3,000	2,000	—
	<1800	1,500	1,000	—

NOTE: Minimum oil viscosity for proper hydraulic end lubrication is 16-20 cST (80-100 SSU).

CAUTION: Do not turn the drive shaft while the oil reservoir is empty.

There should be no trapped air under the oil reservoir diaphragm (71). Refer to Service Procedure #6, “Fill and Seal the Oil Reservoir”, in the Fluid-End Service Section.

Use the appropriate Hydra-Oil for the application (contact Wanner Engineering if in doubt).

CAUTION: If you are losing oil but don’t see any external leakage, or if the oil becomes discolored and contaminated, the diaphragm (22) may be damaged. Refer to the Fluid-End Service Section. Do not operate the pump with a damaged diaphragm.

CAUTION: Do not leave contaminated oil in the pump housing or leave the housing empty. Remove contaminated oil as soon as discovered, and replace it with clean oil.

Check the inlet pressure or vacuum periodically with a gauge.

CAUTION: Protect the pump from freezing. Refer also to the “Shutdown Procedure”.

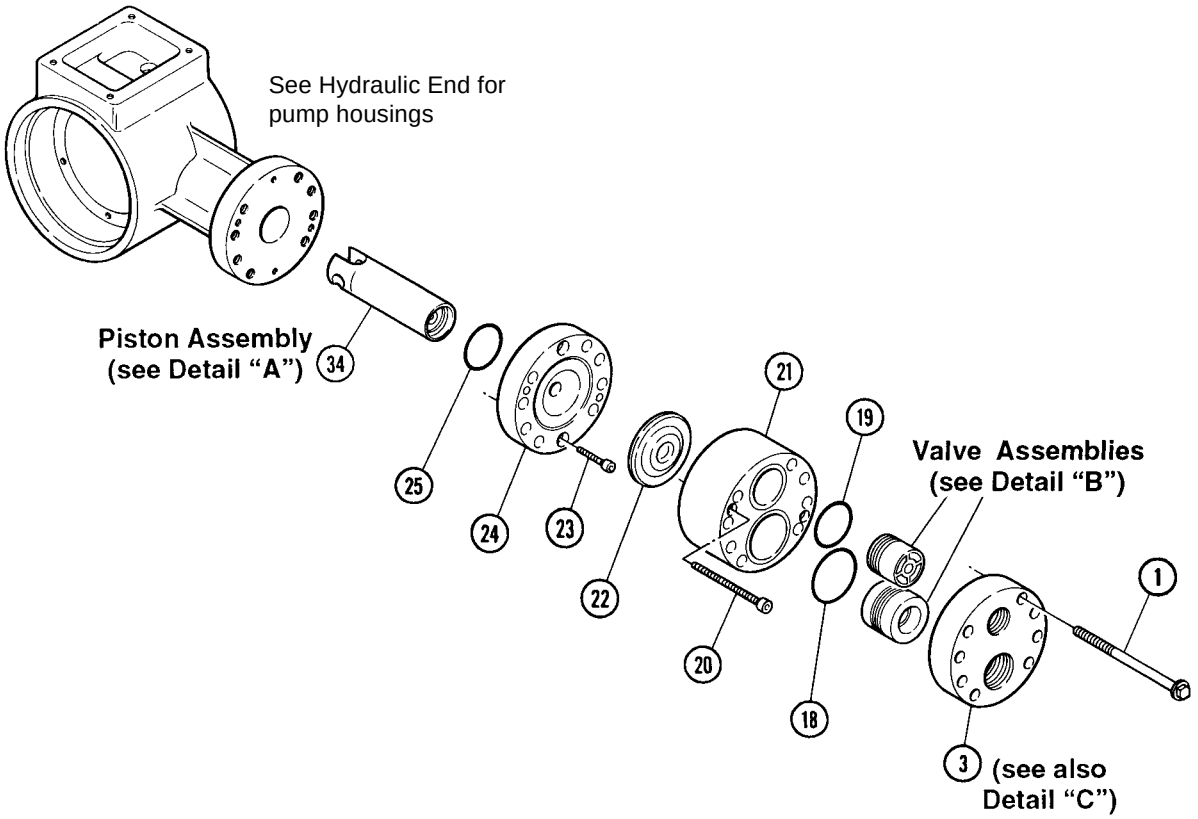
Shutdown Procedure During Freezing Temperatures

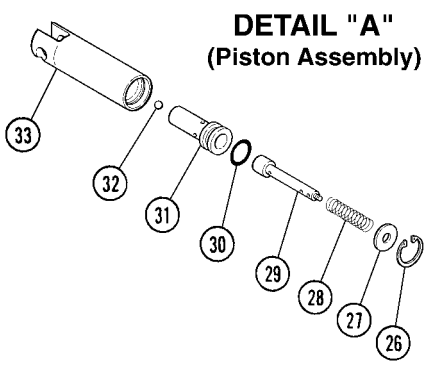
Take all safety precautions to assure safe handling of the fluid being pumped. Provide adequate catch basins for fluid drainage and use appropriate plumbing from drain ports, etc., when flushing the pump and system with a compatible antifreeze.

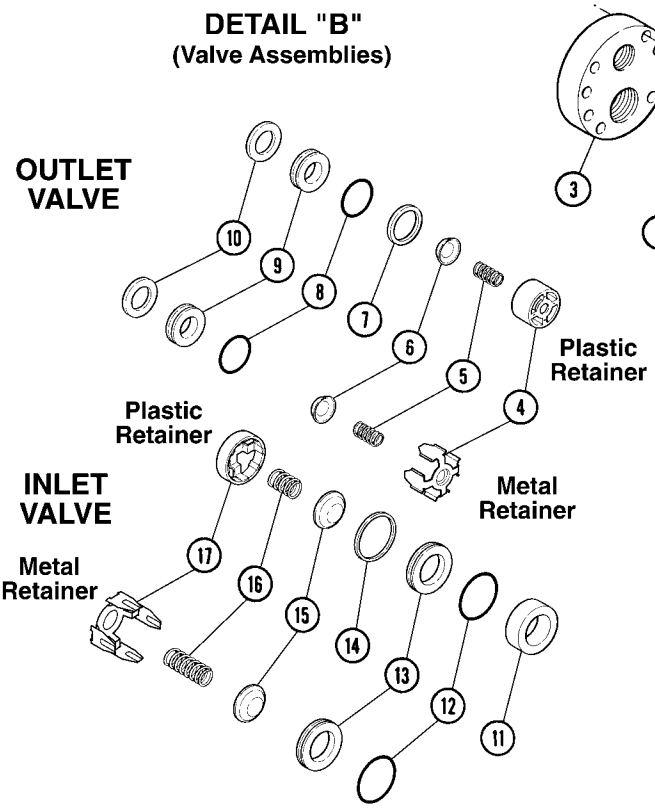
1. Adjust the discharge pressure regulating valve so the pump runs under minimum pressure. Stop the pump.
2. Drain supply tank; open any draincocks in system piping and collect drainage. Drain as much fluid from the pump manifold and plumbing attached directly to the pump manifold by loosening fittings or removing plugs or gauges.
3. Close draincocks in system piping and tighten or replace any fittings, gauges or plugs.
4. Fill supply tank with enough antifreeze to fill system piping and pump.

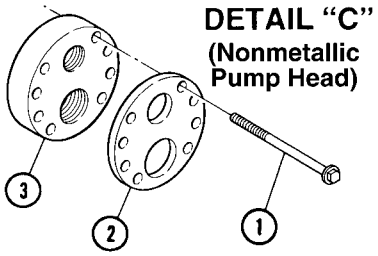
   NOTE: Disconnect the system return line from the supply tank and connect it to a separate reservoir.
5. Start the pump and allow it to run until the system is filled with antifreeze. **NOTE: If the system has an airlock and the pump fails to prime, follow step 4 of the Initial Start-up Procedure to clear the air.**
6. When mostly antifreeze is flowing from the system return line, stop the pump. Connect the system return line back to the supply tank and circulate the antifreeze for a short period.
7. It is also good practice to change the oil in the hydraulic end before storage for an extended period. This will remove any accumulated condensation and sediment from the oil reservoir. Drain and refill the hydraulic end with the appropriate Hydra-Oil and operate the pump for a short period to assure smooth performance.

F/G-20 Service (Fluid End)









Bolt Torque Specifications

Ref. No.	F-20/21/22 (in-lbs)	G-20/21/22 (Ncm)
1	90	1,017
20	14	158
22	10	113
23	14	158

F/G-20 Service (Fluid End)

NOTE: The number in parentheses are the Reference numbers on the illustration at right (also shown in the Parts Manual).

This section explains how to disassemble and inspect all easily-serviceable parts of the pump. Repair procedures for the hydraulic end (oil reservoir) of the pump are included in a later section of the manual.

NOTE: All bolts, nuts, and screws are metric sizes.

CAUTION: Do not disassemble the hydraulic end unless you are a skilled mechanic. For assistance, contact Wanner Engineering (612-332-5681) or the distributor in your area.

1. Remove Manifold (3)

a. Remove all eight bolts (1) around the manifold.

b. Remove the manifold (3).

c. Inspect the manifold for warping or wear around the inlet and outlet ports. If wear is excessive, replace the manifold or return it to Wanner Engineering for resurfacing.

To check if the manifold is warped, place a straightedge across it. A warped manifold should be replaced.

2. Inspect Valves (4-17)

The inlet and outlet valve assemblies are different (the inlet valve is larger) and face in opposite directions. Inspect each valve as follows:

a. Check the spring retainers (4,17), and replace if worn.

b. Check the valve springs (5,16). If shorter than a new spring, replace them (do not just stretch the old spring).

c. Check the valve poppets (6,15). If worn excessively, replace them.

d. Remove the valve seats (9,13). A seat puller is included in the Wanner Tool Kit.

Inspect the valve seats for wear, and replace if necessary. A new O'ring (8,12) should be installed.

e. Check the dampening washers (10,11), and replace if worn.

f. Reinstall the valve assemblies:

• Clean the valve ports and shoulders with emery cloth, and lubricate them with lubricating gel or petroleum jelly (do not use petroleum products when installing EPDM O-rings).

• Install the O-rings (8,12) on the valve seats (9,13).

• **Inlet Valve.** Insert the spring retainer (17) into the valve plate, then insert the spring, valve, Tetra seal, valve seat, and dampening washer (16 - 11). A flat O-ring [Tetra seal] (14) goes between the retainer and seat.

• **Outlet Valve.** Insert the dampening washer, valve seat, Tetra seal, valve, and spring, then the retainer. Install the flat O-ring between the retainer and seat.

3. Inspect and Replace Diaphragm (22)

a. Use a 3-mm Allen wrench to remove the two capscrews (20) from the valve plate (21).

b. Lift the diaphragm by one edge, and turn the pump shaft until the diaphragm moves up to "top dead center". This will expose machined cross holes in the plunger shaft behind the diaphragm.

NOTE: **If the pump has a hollow shaft, use the shaft rotator from the Wanner Tool Kit.**

c. Insert the plunger holder (from the Wanner Tool Kit) through one of the machined cross holes, to hold the diaphragm up. The proper size tool is included in the Wanner Tool Kit. (Don't remove the tool until the new diaphragm is installed in step "G" below).

d. Unscrew the diaphragm. Use an 8-mm or 5/16-in. open-end wrench, and turn counterclockwise.

e. Inspect the diaphragm carefully. A damaged diaphragm generally indicates a pumping system problem, and replacing only the diaphragm will not solve the larger problem. Inspect the diaphragm for the following:

• **Small puncture.** Usually caused by a sharp foreign object in the fluid, or by an ice particle.

• **Diaphragm pulled away from the sides.** Usually caused by fluid being frozen in the pump, or by overpressurization of the pump.

• **Diaphragm becoming stiff and losing flexibility.** Usually caused by pumping a fluid that is incompatible with the diaphragm material.

• **Diaphragm edge chewed away.** Usually caused by overpressurizing the system.

CAUTION: If a diaphragm has ruptured and foreign material or water has entered the oil reservoir, do not operate the pump. Check the diaphragm, then flush the reservoir completely (as outlined below) and refill it with fresh oil. Never let the pump stand with foreign material or water in the reservoir, or with the reservoir empty.

f. Clean away any spilled oil. Apply Loctite #242 Threadlocker to the threads of the new diaphragm (or the old one, as appropriate).

g. Install the diaphragm and tighten to 10 in-lbs.

F/G-20 Service (Fluid End)

4. Flush Contaminant from Hydraulic End (only if a diaphragm has ruptured)

a. With the valve plate and manifold still removed (see above), remove the oil drain cap (69), and the oil reservoir cover (70) and diaphragm (71). Allow all oil and contaminant to drain out.

b. Fill the reservoir with kerosene or solvent, manually turn the pump shaft to circulate the kerosene, and drain. Dispose of this contaminated fluid properly.

CAUTION: If you have an EPDM diaphragm, or if food grade oil is in the reservoir, do not use kerosene or solvents. Instead, flush with the same lubricant that is in the reservoir. Pumps with an EPDM diaphragm have an "E" as the 7th digit of the Model No.

c. Repeat the flushing procedure (step "b" above).

d. Fill the reservoir with fresh oil, manually turn the pump shaft to circulate the oil, and drain once again.

e. Refill the reservoir. If the oil appears milky, there is still contaminant in the reservoir. Repeat the flushing procedure until the oil appears clean.

5. Prime the Hydraulic Cell

a. With the pump **horizontal**, fill the reservoir with the appropriate Hydra oil for the application.

b. All air in the oil within the hydraulic cell (behind the diaphragm) must be forced out by turning the shaft — and thus pumping the piston. A shaft rotator is included in the Wanner Tool Kit.

Turn the shaft until a **bubble-free** flow of oil comes from behind the diaphragm. Watch the oil level in the reservoir; if it gets too low during priming, air will be drawn into the piston (inside the hydraulic end). This will cause the pump to have a loss in flow, and you will have to start over again with priming the hydraulic cell. Fill oil reservoir completely. Add diaphragm seal and install cover plate.

c. Wipe excess oil from the cover plate and diaphragm.

6. Fill and Seal the Oil Reservoir

a. The oil reservoir diaphragm (71) protrudes down into the pump housing approximately 1/4 to 3/8 in. Add oil, if required, so that when the diaphragm is set into the reservoir all air is pushed out.

Take care not to allow any oil overflow to get between the pump housing (62 or 66) and the cover (54). This may result in an apparent oil leak later, when the pump is put into use and heats up.

b. Install the cover (70) using the four bolts.

c. Wipe off any excess oil that got squeezed out onto the outside of the pump housing.

NOTE: The diaphragm (71) will flex up and down slightly as the pump operates. The vent holes in the reservoir cover (70) allow this action to freely occur.

7. Reinstall Valve Plate (21) and Manifold (3)

a. Reinstall the valve plate (21), with the valve assemblies installed as outlined above, onto the diaphragm plate (24).

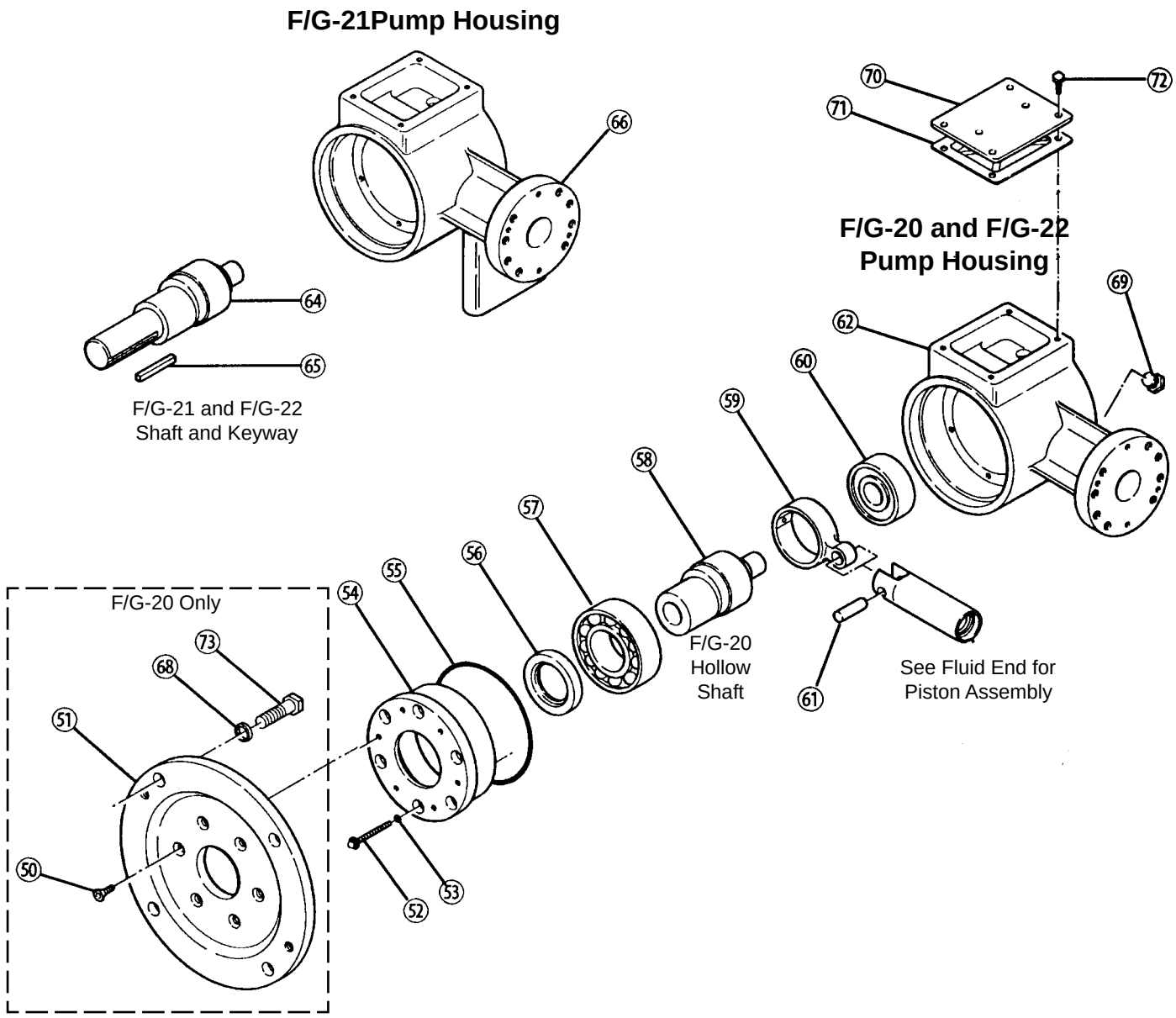
b. Reinstall the O-rings (18,19) onto the valve plate (21). Use petroleum jelly or lubricating gel to hold them in place (do not use petroleum products when installing EPDM O-rings).

c. Reinstall the manifold onto the valve plate.

d. Insert all bolts (1) around the edge of the manifold, and alternately tighten opposite bolts until all are secure. Torque to 90 in.-lbs.

e. Recheck all bolts for tightness.

F/G-20 Service (Hydraulic End)



Bolt Torque Specifications

Ref. No.	F-20/21/22 (in-lbs)	G-20/21/22 (Ncm)
50	35	396
52	14	158
72	10	113
75	35	396

F/G-20 Service (Hydraulic End)

NOTE: The numbers in parentheses are the Reference numbers on the illustration at right (also shown in the Parts Manual).

This section explains how to disassemble and inspect the hydraulic end (oil reservoir) of the pump.

CAUTION: Do not disassemble the hydraulic end unless you are a skilled mechanic. For assistance, contact Wanner Engineering (612-332-5681) or the distributor in your area.

Depending on the repair you are attempting, you may or may not have to remove the motor from a direct-drive pump/motor unit.

Internal piston components (26 - 32) can be serviced without removing the motor or crankshaft. The motor and crankshaft must be removed to service the connecting rod (59), piston (33), crankshaft (58), front bearing (60), back bearing (57), or seal (56).

To Service Piston Without Removing Motor or Crankshaft

1. Disassemble Piston

Remove the manifold, valve plate, diaphragm plate and diaphragm, and drain the oil from the pump (see the Fluid-End Service Section):

a. Remove the snap ring (26) from the piston, using a standard #1 snap-ring pliers.
b. Pull out the valve plunger (29). This also removes the washer (27) and spring (28).
c. (31), and pull the cylinder out of the piston. Be careful not to damage the piston.
d. Inspect all parts, and replace the O-ring and any other parts that are worn or may be damaged.

2. Reassemble Piston

a. Tip the pump so the piston is upright.
b. Drop the ball (32) into the opening in the bottom of the piston.
c. Insert the valve plunger (29) into the valve cylinder (31). Slide the spring (28) over the plunger, inside the valve cylinder.
d. Slide the assembled valve cylinder, plunger, and spring (28 - 31) into the piston (33).
e. Insert the washer (27) over the plunger.
f. Using the snap-ring pliers, insert the snap ring (26) into the piston.

To Remove Motor from Direct-Coupled Unit (F20)

1. Disassemble Motor from Pump

a. Remove the four bolts and flat washers that secure the pump and motor together.
b. Install two of the bolts into the threaded holes in the pump flange (51).
c. Alternately turn the bolts clockwise until the pump and motor separate.

2. Reassemble Motor to Pump

a. Thoroughly clean the motor shaft and the hollow pump shaft.
b. Apply a liberal amount of Loctite Nickel Anti-Seize #77164 to the pump shaft.
c. Install the shaft key into the motor shaft keyway.
d. Slide the motor shaft into the hollow pump shaft.

   CAUTION: When assembling this pump to the direct-coupled motor, be careful that the shaft key remains in the motor shaft keyway and does not ride up the keyway and contact the shaft seal (which would cause premature seal failure). Incorrect key placement could also cause the hollow pump shaft to fail.

   Use a screwdriver to move the shaft key back in the motor shaft keyway as the motor and pump are drawn together.
e. Reinstall the four bolts and flat washers.

To Service Remainder of Hydraulic End

1. Remove Pump Housing

a. Remove the manifold, valve plate, and diaphragm, as outlined in the Fluid-End Service Section.
b. Drain the oil from the pump housing by removing the drain plug (69), and the oil reservoir cover (70) and diaphragm (71).
c. Stand the pump on end, with the drive shaft up.
d. Remove the bolts (52) that secure the cover (54) to the housing (62 or 66). Use a 5-mm socket wrench. Save the O-rings (53).
e. Remove the cover and the cover O-ring (55).
f. Remove the crankshaft (58) by pulling it through the connecting rod (59).

F/G-20 Service (Hydraulic End)

2. Remove and Replace Piston

To remove the piston (33), first remove the connecting rod (59) and pin (61) by pressing the pin through the connecting rod.

Reverse the process to reinstall the piston.

Refer to Steps 5 and 6 below to replace the diaphragm and reassemble the pump.

3. Reassemble Housing and Casting

NOTE: Inspect the shaft seal (56) before continuing. If it looks damaged in any way, replace it. Refer to “Replace Shaft Seal” below.

a. Stand the pump on end.
b. With the piston and connecting rod in place, reinstall the crankshaft by threading it through the connecting rod.
c. Reinstall the cover, cover O-ring, and bolts (with their O-rings).

4. Replace Shaft Seal

a. Press the back bearing (57) and seal (56) out of the cover (54). Discard the seal.
b. Apply a coating of Loctite High-Performance Pipe Sealant With Teflon®, or a comparable product, to the outer surface of a new seal and the inside surface of the opening in the back cover (54) where the seal will rest.
c. Press the new seal into the back cover.
d. Inspect the bearing (57). If pitted or damaged, replace it.

5. Reinstall Diaphragm

a. Screw the plunger puller (from the Wanner Tool Kit or Repair Kit) into the plunger (29). Pull out to expose the cross hole in the plunger. Rotate the shaft until the piston is at top dead center.
b. Insert the diaphragm wrench (from the Wanner Tool Kit), or similar dowel-type object, through the plunger hole — to hold the plunger away from the diaphragm plate (24), and to keep the plunger from turning when the diaphragm is being installed.
c. Apply a small amount of Loctite #242 to the threads of the diaphragm (be sure the threads are clean).
d. Set the diaphragm (22) on the plunger (29), ridge-side out. Screw the diaphragm onto the plunger.
e. Hold the diaphragm wrench, and tighten the diaphragm to 10 in.-lbs of torque.
f. Fill the reservoir with fresh oil and prime the pump, as outlined in the Fluid-End Service Section.

6. Reassemble Pump

Fill and seal the oil reservoir, then reassemble the pump as outlined in the Fluid-End Service Section.

F/G-20 Troubleshooting

Cavitation

- Inadequate fluid supply caused by:
  - Inlet line collapsed or clogged
  - Clogged line strainer
  - Inlet line too small or too long
  - Air leak in inlet line
  - Worn or damaged inlet hose
  - Suction line too long
  - Too many valves and elbows in inlet line
  - NPSHa is less than NPSHr
- Fluid too hot for inlet suction piping system.
- Air entrained in fluid piping system.
- Aeration and turbulence in supply tank.
- Inlet suction vacuum too high.

Symptoms of Cavitation

- Excessive pump valve noise
- Premature failure of spring or retainer (4,5,16,17)
- Volume or pressure drop
- Rough-running pump

Drop in Volume or Pressure

A drop in volume or pressure can be caused by one or more of the following:

- Air leak in suction piping
- Clogged suction line or suction strainer
- Suction line inlet above fluid level in tank
- Inadequate fluid supply
- Pump not operating at proper RPM
- Relief valve bypassing fluid
- Worn pump valve parts
- Foreign material in inlet or outlet valves
- Loss of oil prime in cells because of low oil level
- Ruptured diaphragm (22)
- Cavitation
- Warped manifold from overpressurized system
- O-rings forced out of their grooves from overpressurization
- Air leak in suction line strainer or gasket
- Cracked suction hose.
- Empty supply tank
- Excessive aeration and turbulence in supply tank
- Abrasives in the fluid
- Valve incompatible with corrosives in the fluid
- Pump running too fast
- Worn and slipping drive belt(s)
- Worn spray nozzle(s)

Pump Runs Rough

- Worn pump valves
- Airlock in outlet system
- Oil level low
- Wrong weight of oil for cold operating temperatures (change to lighter weight)
- Cavitation
- Air in suction line
- Restriction in inlet/suction line
- Hydraulic cells not primed after changing diaphragm (22)
- Foreign material in inlet or outlet valve
- Damaged diaphragm (22)
- Broken valve spring (5,16)

Premature Failure of Diaphragm (22)

- Frozen pump
- Puncture by a foreign object
- Elastomer incompatible with fluid being pumped
- Pump running too fast
- Excess pressure

Water in Oil Reservoir

- Condensation
- Ruptured diaphragm (22)
- Hydraulic cell not properly primed after diaphragm (22) replacement
- Frozen pump

Strong Water Pulsations

NOTE: Small pulsations are normal with a single-acting pump.

- Foreign object lodged in pump valve
- Loss of prime in hydraulic cell because of low oil level
- Air in suction line
- Valve spring (5,16) broken
- Cavitation
- Aeration or turbulence in supply tank

F/G-20 Troubleshooting

Valve Wear

- Normal wear

Pump Runs, But Fluid Doesn't Flow

- Unit air-locked

Loss of Oil

- External seepage
- Rupture of diaphragm (22)
- Frozen pump
- Worn shaft seal
- Oil drain, fill cap, or oil reservoir cover loose
- Valve plate and manifold bolts loose

Premature Failure of Valve Spring or Retainer

- Cavitation
- Foreign object in the pump
- Pump running too fast
- Spring/retainer material incompatible with fluid being pumped

Limited Warranty

Wanner Engineering, Inc. extends to the original purchaser of equipment manufacturerd by it and bearing its name, a limited one-year warranty from the date of purchase against defects in material or workmanship, provided that the equipment is installed and operated in accordance with the recommendations and instructions of Wanner Engineering, Inc. Wanner Engineering, Inc. will repair or replace, at its option, defective parts without charge if such parts are returned with transportation charges prepaid to Wanner Engineering, Inc., 1204 Chestnut Avenue, Minneapolis, Minnesota 55403.

This warranty does not cover:

1. The electric motors (if any), which are covered by the separate warranties of the manufacturers of these components.

2. Normal wear and/or damage caused by or related to abrasion, corrosion, abuse, negligence, accident, faulty installation or tampering in a manner which impairs normal operation.

3. Transportation costs.

This limited warranty is exclusive, and is in lieu of any other warranties (express or implied) including warranty of merchantability or warranty of fitness for a particular purpose and of any noncontractual liabilities including product liabilities based on negligence or strict liability. Every form of liability for direct, special, incidental or consequential damages or loss is expressly excluded and denied.

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